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Measuring Preferences for a Diabetes Pay-for-Performance for Patient (P4P4P) Program using a Discrete Choice Experiment

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ABSTRACT

Objective: To elicit a patient's willingness to participate in a diabetes pay-for-performance for patient (P4P4P) program using a discrete choice experiment method. **Methods:** The survey was conducted in March 2013. Our sample was drawn from patients with diabetes at five hospitals in Taiwan (*International Classification of Diseases, Ninth Revision, Clinical Modification* code 250). The sample size was 838 patients. The discrete choice experiment questionnaire included the attributes monthly cash rewards, exercise time, diet control, and program duration. We estimated a bivariate probit model to derive willingness-to-accept levels after accounting for the characteristics (e.g., severity and comorbidity) of patients with diabetes. **Results:** The preferred program was a 3-year program involving 30 minutes of exercise per day and flexible diet control. Offering an incentive of approximately US $67 in cash per month appears to increase the likelihood that patients with diabetes will participate in the preferred P4P4P program by approximately 50%. **Conclusions:** Patients with more disadvantageous characteristics (e.g., elderly, low income, greater comorbidity, and severity) could have less to gain from participating in the program and thus require a higher monetary incentive to compensate for the disutility caused by participating in the program's activities. Our result demonstrates that a modest financial incentive could increase the likelihood of program participation after accounting for the attributes of the P4P4P program and patients' characteristics.

Keywords: diabetes, discrete choice experiment, pay-for-performance for patient (P4P4P), willingness to accept.

Introduction

Many studies indicate that effects of awarding bonuses to physicians/hospitals (pay-for-performance [P4P]) are mixed or nonexistent [1–7]. Such findings indicate a need for further research to explore the effectiveness of P4P. One study also reports that although patient-, physician-, and hospital-level factors affect variations in quality of care, at least 50% of these variations can be explained by patient-level factors [8]. Another study demonstrates that unhealthy or risky patient behaviors have a greater influence on health status than do medical services [9] and these patient behaviors account for 40% of premature deaths in America [10]. These study results suggest that patient factors may be more important drivers of patient health and hospital quality of care than are medical services or hospital rewards.

Intervention at the patient level involves two types of strategies. One is the promotion of patient adherence to physician's prescriptions. The second is enhancing the patient's healthy behaviors. This study focuses on the latter factor. Although numerous factors affect a patient's health behavior, we primarily highlight rewards for the patient, even though this strategy may be somewhat controversial. Health interventions such as a restricted diet and requiring regular physical exercise appear to constrain individual freedom of choice (e.g., lifestyle). From an economic perspective, however, not all those who engage in unhealthy behavior (e.g., smoking) have rational beliefs (e.g., maximize benefits or minimize losses) regarding such behaviors or a desire to change them [11]. According to asymmetric behavior, when patients may have irrational attitudes concerning their unhealthy behaviors, the government or employers should intervene to assist individuals without limiting their freedom of choice [11]. Under such conditions, health intervention by the government is perhaps permissible. Considering the example of exercise in the form of walking, individuals may adopt an

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inactive attitude toward walking because they irrationally believe that changing their exercise habits will be difficult. In such a context, a government or employer could design an incentive program to motivate individuals to overcome their internal (e.g., psychological) barriers [11,12]. These internal barriers arise because most individuals are motivated by actions that produce tangible benefits (e.g., time costs) but are much less motivated by actions that do not produce tangible progress (e.g., reduce the long-term risk of an adverse outcome) toward a goal [11]. Humans generally discount future intangible benefits, and hence, losing weight or exercising regularly, for example, is difficult because indulgent behavior was not substantially responsible for the adverse outcome. Thus, individuals may not accept a lifestyle intervention program. If a government or employer were to offer a cash incentive, however, this could increase the likelihood of participating in a walking program [12].

Incentives/rewards for patients are effective. Many meta-analyses and randomized clinical trial studies demonstrate that patients receiving rewards are more willing to engage in preventive behaviors, including quitting smoking or ceasing drug abuse [13–18]. Certain studies even suggest that offering small rewards to patients may achieve better and longer-term outcomes for patients than does rewarding physicians/hospitals [9,19–21]. In addition to the advantage of improved patient outcomes, incentives allow insurers greater financial savings because payments to patients for preventive behaviors do not involve paying service delivery fees to physicians [9]. Thus, adapting a P4P design that is used to target physicians to instead reward patients, thus creating a pay-for-performance for patients (P4P4P) plan [9,22], may lead to improved outcomes for patients. Taking a diabetes-related P4P4P or lifestyle intervention program as an example, studies demonstrate that when attempting to improve intermediate A_{1c} outcomes (e.g., $A_{1c} < 7\%$), most of the variations lie on the patient side. Patient-level factors account for most of the change in A_{1c} (98%) [23]. Less than 8% of patient A_{1c}-level variations can be explained by physician factors, and a much lower percentage of the variation can be explained by hospital factors [24,25]. For diabetes, the most effective strategy may be to target individual patients and not physicians or hospitals.

Most studies related to diabetes lifestyle interventions derive willingness to pay (WTP) via discrete choice experiments (DCEs) [26,27]. Far fewer studies examine the amount of money that reflects patients' willingness to accept (WTA) participation in P4P4P or lifestyle intervention projects that consist of various program attributes and levels. WTP and WTA are different concepts used to measure the value of participating in lifestyle intervention programs. WTP is the maximum amount that a person would be willing to offer for a good, and WTA is the minimum monetary amount required for an individual to bear some cost or utility loss. Patients with diabetes may be aware of the potential future benefits of participating in the program. Program participation, however, may generate uncomfortable feelings. Thus, patients with diabetes may underestimate the potential future benefits and irrationally persist in their current unhealthy behavior (e.g., inactivity and less control over diet). For such patients, especially those who need to alter their complicating, unhealthy behaviors, which may involve substantial energy and time, such efforts often involve sacrificing positive lifestyle experiences (reducing personal utility) [28]. Thus, patients are less likely to be willing to pay to participate but more likely to be motivated by being paid (thus exhibiting higher WTA) to overcome physical and attitudinal barriers, which may incur a loss of utility due to program participation [12,29–31]. As a result, deriving the WTA value of receiving health intervention is a crucial aspect of P4P4P design.

In addition, other factors argue for the use of the WTA approach to value the benefit of patients with diabetes participating in targeted health programs. One is that P4P programs may generate inequality concerns [32], and P4P4P could help to ameliorate health disparities [22,33]. Furthermore, although a P4P4P plan may help to support the rights of disadvantaged patients, it is unclear whether the disadvantaged persons could be incentivized to participate in such a program at a lower cost [22] or whether larger rewards for participation should be paid to the more severely affected or disadvantaged groups for particularly difficult plans (e.g., smoking cessation, weight loss, and diet control). Moreover, there are results demonstrating that irrespective of whether one considers simple health maintenance or complex life intervention plans, those patients who elect to participate may tend to be healthier or younger [12,26,33–35]. If it is the case, we wonder what monetary reward would be required to encourage disadvantaged persons to participate in such programs. Identifying disadvantaged patients' WTA is crucial because these patients may be more likely to accept benefits from others than to pay for benefits out of pocket. Thus, WTA could be a more suitable measure than WTP for disadvantaged patients. In addition, disadvantaged patients have the potential to obtain greater benefits from participating in a lifestyle intervention program and realize larger cost savings than do typical patients. Thus, in our study, we applied the DCE method to determine patients' willingness to participate in a diabetes P4P4P program, with a particular focus on disadvantaged patients, and explored the likelihood of participation of patients under different acceptable prices.

Methods

Study Sample

The hospitals in this study were selected to balance the socioeconomic differences between urban and rural areas and cover different capacity levels (district, regional, and tertiary hospitals). Diabetes educators distributed questionnaires to all patients with type 2 diabetes (*International Classification of Diseases, Ninth Revision, Clinical Modification* code 250) who were treated in five hospitals located in eastern, southern, and northern parts of Taiwan from March to June 2013.

To determine whether our sample was representative of the entire diabetes population in Taiwan, we compared selected variables with information from the National Health Insurance's (NHI's) 2008 diabetes database. The database comprises 1 million samples randomly retrieved from the Taiwanese population. The variables used to validate our study sample included age, sex, income, degree of urbanization in the area of residence, comorbidity, and severity (relevant definitions are provided in the following paragraph).

Study Format

We used the DCE method to elicit WTA participation in the diabetes P4P4P plan with respect to several attributes. Because the maximum number of selected attributes should not exceed five or six [36], only four attributes were included in the study and are presented in Table 1. They include one incentive attribute (monthly cash rewards for program participation), two activity attributes (exercise per day and flexibility of diet), and one program design attribute (program duration) identified from evidence-based articles [37] and established through the focus group. For the incentive attribute, we also obtained information on the range of WTA values for patients with diabetes participating in the focus group, who reported the price range that would secure their participation in the program. The range was between US \$33 and US \$100 (US \$1 equals ~30 New Taiwanese [NT] dollars).

Three experts ensured content validity by verifying that the design of the DCE was robust and that the format and questions

Table 1 – Attributes and levels of the P4P4P incentive design.

Attribute	Description	Level	Idea source
1	Cash rewards per month (NT*)	1000 2000 3000	Focus group
2	Exercise per day	30 min 50 min	[27]
3	Diet	Flexible, low-calorie diet Restricted diet (strictly following the dietitian's suggestions)	[27]
4	Program duration	1 y 3 y	[37]

NT, New Taiwanese; P4P4P, pay-for-performance for patient.
* US $1 is approximately NT$30.

Choice set 1	**Prefer A** ☐	**Prefer B** ☐
	Please select the preferred one	
	Alternative A	Alternative B
Cash rewards per month	NT$2000 (US$67)	NT$3000 (US$100)
Exercise per day	**30** minutes	**50** minutes
Diet	Flexible, **low-calorie** diet	**Restricted diet**
Program duration	**One** year	**Three** years
Compared with your current situation (participating in an existing program/not participating in any program), would you still choose the alternative you chose above?		
Yes	☐I would choose any of the alternatives above	
No	☐I would choose to maintain my current situation and not participate in any of programs described above	

Fig. 1 – An example of the choice sets.

were clear to the respondents. We then performed a pilot test with 20 patients with diabetes. We asked each hospital's certified diabetes educator to administer the questionnaire. The primary investigators also trained the diabetes educators in the important details of the questionnaire, such as how this type of DCE questionnaire should be administered. If the respondents could not read or were unfamiliar with the questionnaire form, we asked the interviewers to read the entire questionnaire in a manner that the interviewees could understand. To obtain complete patient comorbidity and severity information, we provided a list of associated diseases from the literature to allow the patients to select the appropriate levels of comorbidity and severity [38,39]. After the completion of the questionnaire, we also required the interviewers to verify the demographic information that the patients provided.

To ensure that individuals acquired all relevant information before completing the choice sets [40], we provided a summary sheet of all attributes and levels before the main choice section of the questionnaire.

The four attributes and their levels gave rise to 24 possible scenarios in a full factorial design ($3 \times 2 \times 2 \times 2$). A D-optimization algorithm was used to generate a blocked fractional factorial design that jointly maximizes the principles of orthogonality, level balance, minimal overlap, and utility [41]. In addition, in theory, the increased-overlap method (in which some attribute levels are identical across all sets of scenarios) could reduce the cognitive burden, meaning that respondents may feel less fatigue and experience fewer difficulties. Previous empirical results indicate, however, that while the two methods do not differ with respect to consistency and perceived difficulty, the minimal-overlap method can increase efficiency. Thus, we adopt the minimal-overlap method (in which attribute levels varied between each set of scenarios) (please refer to the upper part of Fig. 1) [42].

Fifteen choice sets were generated. Each choice set had two pairwise sets of scenarios. To simplify the questionnaires to increase the response rate, the 15 choice sets were randomly allocated into three blocks. Each respondent was randomly assigned to one of the three blocks and completed one of three surveys containing five choice sets plus two rationality/consistency test choice sets, which included dominance, and expanded tests. Appendix 1 in Supplemental Materials found at http://dx.doi.org/10.1016/j.jval.2015.03.1793 describes the rationales for the consistency tests in detail. In addition, after making their choices, the respondents were asked to rate, on a scale ranging from 1 (very easy) to 5 (very difficult), the difficulty of the entire DCE questionnaire.

Patients' Characteristics

We accounted for numerous characteristics of patients with diabetes, including age, income, education, employment, obesity status, comorbidity, severity, duration of diabetes, and degree of urbanization because these characteristics may affect a patient's willingness to participate in diabetes or other types of lifestyle prevention programs [12,26,43].

We stratified the patients' areas of residence into seven urbanization categories according to the standard published by Taiwan's National Health Research Institute. This urbanization index consists of five measures: population density, education level, percentage of elderly persons, percentage of agricultural workers, and medical resources. The National Health Research Institute uses cluster analysis to divide all the Taiwan's districts into seven urbanization groups according to these measures: high-level, medium-level, emerging, general, aged, agricultural, and remote [44]. To account for patient comorbidity, we adopted the Chronic Illness with Complexity method [38]. This index includes diseases such as cancer, gastrointestinal only, pulmonary only, musculoskeletal only, substance abuse, and mental illness. For patient severity, we adopted Selby et al. and Rosenzweig et al.'s Diabetes Complications Severity Index [39], which includes seven categories of complications: retinopathy, nephropathy, neuropathy, cerebrovascular complications, cardiovascular complications, peripheral vascular disease, and metabolic complications. We treated patient comorbidity and severity as binary variables. If a patient exhibited any of these comorbidities or severities, he or she was coded 1 for the comorbidity or severity variable, 0 otherwise.

Analysis

We followed suggestions from previous rigorous studies and used a two-step design for the questionnaire [12,45]. For each choice set, the respondents were first asked to identify which of the two alternatives they would prefer. The respondents were then asked to choose between that preferred alternative and not participating in any alternative. An example of the choice sets is presented in Figure 1. This two-step design maximizes the information obtained concerning both trade-offs among program attributes [45]. For levels of categorical attributes, we used effects codes instead of dummy codes to avoid status quo bias (the reference level is assigned a value of −1 instead of 0) [46], whereas incentive cost and program duration were treated as continuous variables. In addition, for the two-step design, the dependent variables (the choice between two alternatives vs. the subsequent choice of whether to participate) are correlated; hence, we generated coefficients for each level from a bivariate probit model [12,45]. After determining the coefficients of each level according to the absolute difference between the coefficients for the highest and lowest levels, we were able to determine the relative importance of each attribute. We used SAS Version 9.3 to generate choice sets and estimate the bivariate probit model.

Similarly, on the basis of these derived parameters, we were able to estimate the different acceptable prices for the distinct program designs. We calculated the WTA values/prices under three conditions: the prices calculated from the total samples, the prices calculated when excluding irrational cases (the subject failed one or both tests), and the marginal prices for an increase in one comorbidity or severity count. All prices were measured and calculated in NT dollars and converted into and reported as US dollars for international comparisons. For the first two models, we treated comorbidity and severity variables as binary variables and treated the comorbidity and severity variables as continuous counts when calculating the marginal prices of a one-unit increase in the disease burden in the final model. Finally, we also calculated the predicted probability of participation on the basis of program designs (program attributes) and patient characteristics.

Results

The original sample size was 843 subjects. We excluded information for five subjects because of missing patient characteristics; therefore, the final sample included 838 subjects. Nine patients partially completed the preference questions, and hence, we retained them in the final sample for analysis.

Table 2 reports that 25% of the respondents were 65 years or older. Moreover, 48% of the respondents were female, 57% had an income of less than US $1000, 27% had an education below elementary school, 42% were retired, 19% were living in low-urbanization areas, 17% were obese (body mass index $\geq$ 30), 31% had one or more comorbidity, 44% had some degree of severity, and 70% had a diabetes duration of more than 3 years. The format of the questionnaire appears to have been thoroughly user-friendly and understandable because approximately 97% of the patients (810 of 838) did not consider the survey to be difficult (data not reported). When comparing the sample and the nationwide data using the six variables extracted from the database, we found that the distributions of sex, level of urbanization, and severity were similar for both groups. Our sample was moderately younger and wealthier and presented with somewhat less comorbidity.

Table 3 reports the estimated participation in a specific P4P4P program derived from the bivariate probit model with and without interaction terms. Models 1 and 2 are the probit model without and with interaction terms, respectively; model 3 was estimated after dropping the 33 irrational cases, and model 4 was estimated after dropping the 160 patients failing at least one test. All four P4P4P design attributes were significant ($P < 0.001$), and except for the cash incentive, the other three attributes' parameters in model 3 and model 4 were somewhat higher than those obtained in the other models. For example, regarding the flexible diet variable, its parameter becomes large (from 0.161 [model 2] to 0.175 [model 3]) when the irrational respondents are removed. This indicates that the flexible diet design included in that plan can serve to substantially offset the utility loss from program participation. Thus, there is no need to award additional money to compensate for the utility loss from participating in the program (see also Table 4). In contrast, the nonpreferred levels (e.g., a strict diet) also increased; therefore, additional money

Table 2 – Respondents' demographic characteristics compared with those of the entire diabetes population.

Variable	Study sample (N = 838)	2008 population (N = 28,236)
Age (y)		
<65	625 (75)	16,210 (57)
≥65	213 (25)	12,026 (43)
Sex		
Male	432 (52)	13,987 (50)
Female	406 (48)	14,249 (50)
Income (US $)		
<1000	477 (57)	23,754 (84)
≥1000	361 (43)	4,482 (16)
Education		
Below elementary school	227 (27)	
Above elementary school	611 (73)	
Employment		
Retired	349 (42)	
Working	489 (58)	
Living area*		
Low urbanization	158 (19)	6,107 (22)
High urbanization	680 (81)	22,129 (78)
Obesity		
BMI ≥30	145 (17)	
BMI < 30	693 (83)	
Comorbidity†		
Yes	256 (31)	12,728 (45)
No	582 (69)	15,508 (55)
Severity‡		
Yes	368 (44)	11,946 (42)
No	470 (56)	16,290 (58)
Duration > 3 y		
Yes	586 (70)	
No	252 (30)	

Note. BMI = weight (kg)/height(m)^2. Values are n (%).
BMI, body mass index.

* Living area: the high-level, medium-level, and emerging areas are classified as a high level of urbanization, and the general, aged, agriculture, and remote areas are classified as a low level of urbanization.

† Comorbidity: a patient with any of the following six diseases: cancer, gastrointestinal, pulmonary, musculoskeletal, and mental illness, and substance abuse.

‡ Severity: a patient with any of the following seven diseases: retinopathy, neuropathy, nephropathy, cardiovascular, cerebrovascular, and peripheral vascular disease, and metabolic syndrome.

Table 3 – Bivariate probit model estimates.

Variable	Model 1		Model 2		Model 3		Model 4	
	Coefficient	SE	Coefficient	SE	Coefficient	SE	Coefficient	SE
Cash incentive per NT $1000	0.139*	0.004	0.139*	0.004	0.137*	0.004	0.128*	0.004
Program duration	0.095*	0.004	0.095*	0.004	0.096*	0.004	0.107*	0.004
Flexible, low-calorie diet	0.161*	0.005	0.161*	0.005	0.175*	0.005	0.218*	0.005
Restricted diet	−0.161*		−0.161*		−0.175*		−0.218*	
Exercise: 30 min/d	0.094*	0.005	0.094*	0.005	0.108*	0.005	0.133*	0.005
Exercise: 50 min/d	−0.094*		−0.094*		−0.108*		−0.133*	
No participation (NoPrg)	0.032*		0.006*	0.001	0.007*	0.001	0.006*	0.001
Interaction terms (NoPrg × Patient factors)								
NoPrg × Female			0.227*	0.011	0.208*	0.012	0.122*	0.012
NoPrg × Age ≥65 y			0.228*	0.018	0.195*	0.019	0.184*	0.019
NoPrg × Income of ≤US $1000			0.081*	0.014	0.081*	0.015	0.140*	0.014
NoPrg × ≤Elementary school			−0.254*	0.014	−0.243*	0.017	−0.259*	0.018
NoPrg × Retried			−0.074*	0.015	−0.082*	0.014	−0.052*	0.014
NoPrg × Obese			0.411*	0.016	0.415*	0.016	0.374*	0.016
NoPrg × Low urbanization			0.439*	0.013	0.438*	0.014	0.462*	0.014
NoPrg × Comorbidity			0.327*	0.011	0.304*	0.012	0.290*	0.012
NoPrg × Severity			0.106*	0.011	0.115*	0.011	0.028†	0.012
NoPrg × Diabetes duration			0.590*	0.010	0.613*	0.011	0.676*	0.011

Note. Cash incentive and program duration are continuous variables. NoPrg (binary variable): NoPrg = 1 if respondents chose not to participate in the program after assessing the trade-offs between a pair of alternatives. Models 1 and 2 are the probit model without and with interaction terms, respectively; model 3 is the model that eliminates the 33 irrational cases failing both the two tests; model 4 is the model that removes all 160 patients failing at least one test.
SE, standard error.
* $P < 0.001$.
† $P < 0.05$.

must be invested in those nonpreferred attribute combinations. Aside from cash incentives, the most-preferred attribute combinations, in descending order, are a flexible, low-calorie diet, longer program duration, and less exercise time per day for models 1 and 2. The most-preferred attribute is dieting style: a flexible, low-calorie diet is preferred across the four models.

All the patient characteristics interacted with the no participation variable. The variable with the greatest negative influence is diabetes duration. The longer a patient has diabetes, the more difficult it is for the patient to exercise regularly and control his or her diet; therefore, a larger amount of money must be invested to secure participation. Moreover, other disadvantaged patients, such as those who are elderly, have low income, are obese, and live in low-urbanized areas or who experience more comorbidities or greater severity, may be more likely to not participate in the program; therefore, they require larger payments to compensate for the decreased utility of the initiatives.

The parameters derived from the model in Table 3 can be used to estimate the cash incentives required to compensate patients with diabetes for the lack of difference between participating in a P4P4P program and not participating in the program. In Table 4, the most-preferred program (e.g., a 3-year P4P4P program with a flexible diet and 30 minutes of exercise per day) required the least compensation for the loss in utility, US $37 to US $70 per month. Reducing the P4P4P program by half a year required 1.5 times more compensation, US $79 to US $104. Adding the restricted diet requirement to the most-preferred program will require an increase of US $77 to US $114.

Table 5 indicates that there is an approximately 50% probability of participating in the program if it is designed as a 3-year program with a flexible diet and 30 minutes of exercise per day with cash rewards of US $67 per month.

Table 4 – Cash incentive (US $) per month needed to compensate for the loss of utility under different program designs.

Duration (y)	Flexible diet		Restricted diet	
	30 min/d	50 min/d	30 min/d	50 min/d
0.5	127*	172*	204*	249*
	121†	174†	206 †	259†
	107‡	176‡	220‡	290‡
1.0	116*	161*	193*	238*
	110†	162†	195†	247†
	93‡	162‡	207‡	276‡
1.5	104*	149*	182*	227*
	98†	150†	183†	236†
	79‡	148‡	193‡	262‡
2.0	93*	138*	170*	215*
	86†	139†	171†	224†
	65‡	134‡	179‡	248‡
2.5	82*	127*	159*	204*
	75†	127†	160†	212†
	51‡	120‡	165‡	234‡
3.0	70*	115*	147*	193*
	63†	115†	148†	201†
	37‡	107‡	151‡	220‡

* Figures are derived from the original sample (n = 838).
† Figures are derived from the sample excluding the irrational cases that failed both the two tests (n = 805).
‡ Figures are derived from the sample excluding irrational cases that failed either of the two tests (n = 678).

Table 5 – Predicted probability of participation in programs under different cash incentives.

Money per month (NT $)	Flexible diet						Restricted diet					
	30 min/d			50 min/d			30 min/d			50 min/d		
	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3	Year 1	Year 2	Year 3
1000	0.37	0.40	0.44	0.30	0.33	0.37	0.25	0.28	0.32	0.20	0.22	0.25
2000	0.42	0.46	0.49	0.35	0.38	0.42	0.30	0.33	0.37	0.24	0.27	0.30
3000	0.47	0.51	0.55	0.40	0.44	0.47	0.35	0.38	0.42	0.28	0.32	0.35
4000	0.53	0.57	0.60	0.45	0.49	0.53	0.40	0.44	0.48	0.33	0.37	0.40
5000	0.58	0.62	0.66	0.51	0.55	0.58	0.46	0.49	0.53	0.38	0.42	0.46
6000	0.64	0.67	0.71	0.56	0.60	0.64	0.51	0.55	0.59	0.44	0.47	0.51
7000	0.69	0.72	0.75	0.62	0.65	0.69	0.57	0.60	0.64	0.49	0.53	0.57
8000	0.74	0.77	0.79	0.67	0.70	0.74	0.62	0.66	0.69	0.55	0.58	0.62

Note. Year indicates the duration of the program (US $1 = NT $30).
NT, New Taiwanese.

Discussion

There is a lack of studies applying the DCE method to elicit diabetes patients' preferences for intervention programs, such as the P4P4P design. The study found that the preferred P4P4P program for patients with diabetes involved a 3-year program with 30 minutes of exercise per day and a flexible diet. We constructed a rigorous WTA model to estimate the acceptable prices under different program designs after considering patient characteristics likely to reduce participation, such as patients who were elderly, have low income, are obese, or reside in low-urbanized areas and those with greater comorbidity and severity and a longer diabetes history. The patients with diabetes with these characteristics (comorbidities, poor, etc.) will experience less utility from participating in the program because they face a larger personal cost. These types of patients will benefit more from participating in the program, but larger financial rewards are required to motivate these patients. We found that a moderate incentive can encourage patients with diabetes to participate in the P4P4P program. Patients require only approximately US $37 to US $70 per month to be indifferent between participating in the most-preferred program relative to no participation. Those participating in the lifestyle intervention program must engage in the healthy behaviors, such as diet control and additional exercise, which can improve their health, but patients may perceive a utility loss from engaging in these behaviors because of discomfort experience. Financial incentives, however, can be used to compensate for this loss and hence return participants' utility to the original level they had experienced before participating (no difference) [12,45]. In addition, we demonstrated that patients with a comorbidity (or severe disease/complication) have a WTA value that is US $24 (US $11) higher than that of those who have none of the prespecified comorbidities (or severe diseases/complications). The marginal cost of approximately US $44 must be paid when the average participating patient presents a one-unit increase in the comorbidity count, and US $17 is the required cost if he or she faces a one-unit increase in the severity count (data not shown). Finally, we demonstrated that there is an approximately 49% probability of participation when the most-preferred program design was offered, with payments of US $67.

The respondents preferred a longer program duration. One research revealed that among the attributes of the diabetes patient intervention program, only financial payments influence willingness to participate, whereas other attributes (e.g., time spent on the activity) do not [47]. Thus, when patients decide whether to participate in the program, money may play a crucial role [43,48,49]. The patients may perceive that they will receive greater benefits when participating in the longer duration program. After agreeing to participate, however, patients may feel uncomfortable or struggle to adapt and hence withdraw from the program. Nevertheless, patient participation in the longer duration program that offers larger incentives is beneficial because complex behaviors (e.g., changing dietary and exercise patterns and medication adherence) require effort over a period of time and often sustained behavior modifications [21,37]. Thus, if we were to create a long-term intervention plan that includes a long-term bonus to incentivize patient participation, perhaps we can improve the participation rate in the long-term program, and hence, the complex behaviors of the participating patients could be changed.

Many recent studies eliciting preferences are more likely to use the DCE method. For example, many diabetes-related preference studies focus on the WTP for treatment outcomes, such as the reduction in weight, A_{1c}, or hypoglycemic events [50,51]; therefore, the prices derived from such research indicate that patients with diabetes are willing to pay to achieve the targeted outcome. Few articles emphasize WTP for lifestyle programs that prevent the deterioration of patients with diabetes. In other words, these types of programs value regular activities, such as limited diets and increased exercise to maintain health status, while the participants pay a certain amount of money to achieve the desired diabetic outcome [26,27]. These studies, however, consider WTP rather than WTA. There is lack of studies on diabetes intervention programs that use the WTA method. Our study uses a WTA approach based on the perspective of utility loss [30,31]. In the long run, patients can benefit from participating in a lifestyle intervention program (e.g., health promotion). Patients, however, may not be particularly rational or perceive such long-term benefits, and instead, they may subjectively believe that they will incur substantial costs or face numerous difficulties when participating in such a program. Patients often emphasize such costs (e.g., time investment and physical discomfort) over future benefits [12,43,45]. Thus, such intervention plans typically exhibit low participation rates, especially complex plans, such as diabetes or obese lifestyle intervention plans [26,43,52,53]. For example, only 40% of obese patients engage in weight control practices, and only 15% of eligible persons participated in a German disease management program [47,53,54]. A possible explanation for this is that if the patients were required to engage in specified levels of physical activity or dietary control, they would incur a utility loss, whereas they otherwise would have chosen to either remain inactive or engage in lower levels of physical activity or dietary control. Thus, WTA, which focuses on the loss of a good, represents a promising approach because it measure the average loss that patients are willing to accept in exchange for participating in a specific program that may be associated with a loss of time or dietary freedom.

In addition, individuals participating in these types of programs or satisfying program requirements of physical activity or dietary control within the specified time are typically healthier, younger, or from more advantaged socioeconomic groups [12,26,33–35,53,55]. For example, regarding exercise (an important regime for diabetes), there are many barriers that reduce overall physical activity levels among disadvantaged patients. These barriers may be individual factors (e.g., older age, poor health [e.g., obesity and depression], and lower education) and community factors (e.g., living arrangements) [56–60]. Compared with other healthier patients, these factors are more significant for disadvantaged patients or patients with greater comorbidity/severity, and hence the latter may be much less prone to participate in a program [33]. Monetary incentives play a critical role in promoting program participation or regular exercise, as the aforementioned studies have noted [43,47,48]. Greater monetary incentives may be necessary to promote participation in plans or change behavior among disadvantaged or more severe patients. This conclusion is consistent with empirical studies reporting that adults or patients, especially those who are disadvantaged or in poor health, require larger monetary incentives to participate in walking or colorectal cancer screening programs, respectively [12,45]. Thus, for the disadvantaged groups, WTA is crucial in exploring whether they would be willing to participate in complex behavior change programs.

In our study, we used a WTA perspective and determined the money amounts using a choice-format questionnaire. We not only applied the novel PREFS checklist for conjoint or discrete choice experiments [61] but also assumed that numerous disadvantageous factors increased the participants' utility loss, which therefore required greater monetary compensation to incentivize participation. By applying the WTA framework and considering the disadvantageous factors presented by patients with diabetes (e.g., more comorbidities, greater severity, and long duration), the average patient is willing to accept US $67 per month (US $800 per year) to participate in the 3-year P4P4P plan with a flexible diet and 30 minutes of exercises per day, and the likelihood of participation is up to approximately 49%. The price of US $67 per month falls in the middle of the price range that was derived from the focus group conducted before the main study.

Compared with other studies related to patients' willingness to participate in diabetes intervention programs, van Gils et al.'s [47] study did not clearly identify the amount of monetary compensation required to make patients with diabetes willing to participate in the program [47]. Wanders et al.'s [62] recent study found that a maximum amount of approximately €300 (financial reward of €75 for 3 months) over 1 year (US $369) would achieve a 50% participation rate. This study, however, devoted little attention to the patients' characteristics affecting patients' willingness to accept the program. In addition, their study had a low response rate (27%). Bonevski et al.'s study of a smoking cessation program in 2010 found that 65% of the smokers were likely to participate in the program if they were to receive an incentive, and among them, 50% hope to receive the preferred incentive amount of approximately AU $1500 per year (US $1455; AU $1 = US $0.97 in October 2010) to participate in the program. The amount is similar to that observed for our 1-year preferred program (flexible diet and exercise for 30 min/wk), which requires an incentive of US $1344 per year (US $1 = NT$31 as of October 2010) [63]. Our analysis from the perspective of utility loss stress that patients presenting with disadvantaged characteristics will be less likely to participate in the program, and hence a larger monetary reward should be paid to compensate for the utility loss incurred from participation in the program. A WTA study of typical elderly individuals participating in a walking program (30 minutes of walking per day, 5 d/wk) [12] reported that a larger annual incentive (~US $1700–US $3500) was required than that observed in our diabetes WTA study. This difference may indicate that patients with diabetes valued certain benefits of exercise and diet control to a large enough extent to only require a partial incentive to compensate for their lost utility. Compared with normal, healthy individuals, patients with diabetes may perceive higher benefits of exercise (e.g., walking); hence, the WTA value for participating in the walking intervention plan was higher than that for our diabetes intervention program. In summary, our study demonstrated that offering an incentive of US $800 per year may result in an approximately 50% likelihood of encouraging patients with diabetes to participate in the preferred diabetes intervention program. We believe that the annual per-patient cost of US $800 proposed in our study is reasonable in light of the disadvantageous characteristics presented by the patients. If we do not consider the characteristics of disadvantaged patients and consider only the least-preferred program design (restrict diet, exercise for 50 min/wk, a 1-year duration), the required incentives should be approximately only half (US $456 per year) those required to compensate for the utility loss in the most-preferred program. This represents a substantial cost reduction. Similarly, we found that the WTA value associated with patients with a one-unit increase in comorbidity among patients with diabetes is higher (at approximately US $27; [US $44–US $17]) than that for a one-unit increase in severity. This result is understandable because patients with diabetes-related severity may be more likely than patients with a comorbidity unrelated to diabetes to satisfy the strict requirements of the programs (e.g., more exercise and limited diet).

Ultimately, some may argue that US $800 per patient per year is a significant amount of money to compensate patients for a diet and exercise intervention and wish to know the total cost of this intervention and the potential savings to the health care market. According to Taiwan's data on the country's diabetes epidemic, we can approximately estimate the cost-effectiveness of the plan [64,65]. In 2009, there were 1.22 million patients with diabetes in Taiwan (30,000 patients requiring dialysis services). If all the patients with diabetes were paid an amount of US $800 per year to participate in the lifestyle intervention program, the cost would be approximately US $0.98 billion. This is under the assumption that every patient participating in the program had the same high adherence rate, and hence their A_{1c} level was under appropriate control, thereby reducing the possibility of admission for these patients. Under this assumption, admission fees would be reduced by approximately US $1.47 billion. In the optimal scenario, the implementation of this diabetes plan could save approximately US $0.5 billion in costs and hence reduce medical expenditures. This is a very rough estimation, however, and further empirical studies in the Taiwanese context would be necessary to demonstrate that this type of diabetes plan could reduce medical costs.

There are some limitations of this study. The study sample selected from five hospitals differs somewhat from the national population in 2008. Our sample was younger, had modestly higher incomes, and less comorbidity than did the national population. Regarding income, our information may be more accurate because NHI's income data are calculated on the basis of premiums. Most important, most Taiwanese authorities, such as central or local governments, may eliminate premiums for certain patients. Our income information considers any income (including income from the patient's offspring); therefore, it is more accurate than the NHI's premium variable. Regarding the two underestimated variables (age and comorbidity), by applying the information retrieved from the database into the formula, we found that there was a 31% increase in the incentive (~US \$21 + US \$67 per month; data not reported) required to compensate an older program participant presenting more comorbidities. The result, however, still represents a cost savings (the investment cost [US \$1.29 billion] vs. the admission cost [US \$1.47 billion]); data not reported). In addition, in our study, the patients were informed that they would be monitored while participating in the P4P4P program. We did not describe the monitoring procedure in detail in the DCE questionnaire. We did not inform patients that they might have to wear a device to monitor physical activity and have blood work done to monitor their diet. These factors may influence the amount of compensation that the patients believe they should receive in return for participation. Few empirical studies, however, have demonstrated that these factors are critical in influencing willingness to participate in a program. Few diabetes DCE studies related to lifestyle intervention programs have provided such relevant information to patients, and the DCE method cannot capture all the detailed processes involved for patients participating in the program. In addition, for simplicity, less loading, and greater accuracy, we administered only five choice sets, in addition to the rationality test, to every respondent. From the pretest of the questionnaire, we found that because of the new P4P4P concept and the specific questionnaire form (DCE), some of the older respondents needed the interviewer to explain every choice set or even read each set of two alternatives to accurately select one. Thus, we randomized the participants into three groups and asked them to respond to only 5 choice sets (excluding two items related to rationality and dominance testing) that were randomly selected from the 15 choice sets. Thus, although all the respondents ultimately completed a slightly lower number of choice sets, the questionnaire nevertheless maintains the rigorous characteristics of a DCE survey. In total, 97% of the respondents indicated that the questionnaire was not difficult and that they could easily determine the meanings of the choice sets and accurately report their preferences.

Conclusions

The results suggest that the characteristics of a diabetes P4P4P program, such as exercise time, diet control, and program duration, substantially influence patients' willingness to accept the program. The more disadvantaged characteristics that a patient presented (e.g., more comorbidities and greater severity), the lower the utility associated with program participation and the larger the monetary incentive required to compensate for the loss of utility. Our result demonstrates that a modest financial incentive can increase the likelihood that a patient will participate in a program after accounting for the P4P4P program's attributes and patients' characteristics.

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